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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST INSECT INVESTIGATIONS

REPORT OF PINE BEETLE SURVEYS on the DESCHUTES NATIONAL FOREST, OREGON 1931-1938

By
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February 1939

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REPORT OF PINE BEETLE SURVEYS ON THE DESCHUTES NATIONAL FOREST, OREGON

1931--1938

February 1939

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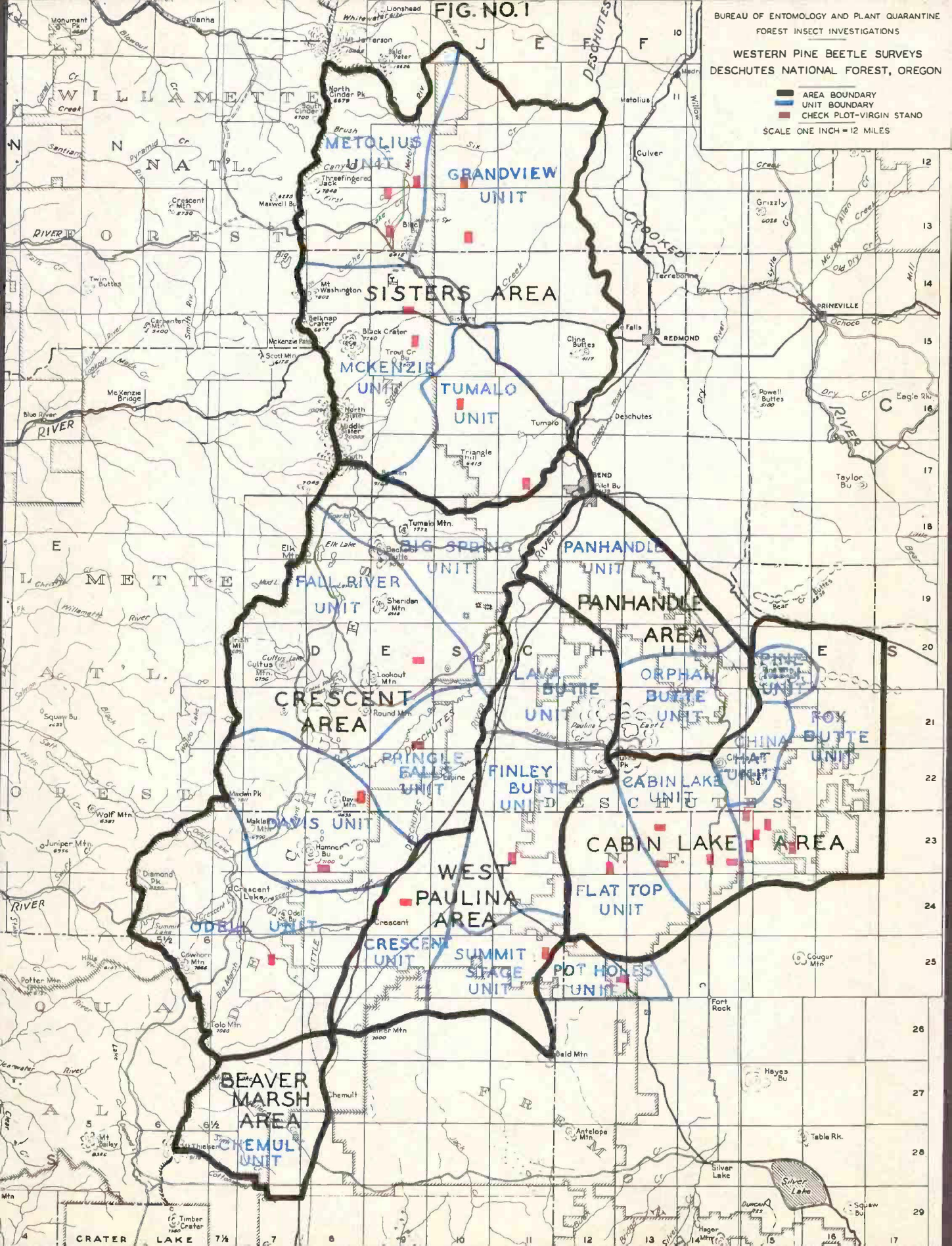


FIG. NO. 1
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
FOREST INSECT INVESTIGATIONS
WESTERN PINE BEETLE SURVEYS
DESCHUTES NATIONAL FOREST, OREGON
AREA BOUNDARY
UNIT BOUNDARY
CHECK PLOT-VIRGIN STAND
SCALE ONE INCH = 12 MILES
METOLIUS UNIT
GRANDVIEW UNIT
SISTERS AREA
MCKENZIE UNIT
TUMALO UNIT
BIG SPRING UNIT
PANHANDLE UNIT
PANHANDLE AREA
FALL RIVER UNIT
CRESCENT AREA
LAVA BUTTE UNIT
ORPHAN BUTTE UNIT
PINE FOREST UNIT
FOX BUTTE UNIT
CHINA CHAT UNIT
PRINGLE FALLS UNIT
FINLEY BUTTE UNIT
CABIN LAKE UNIT
DAVIS UNIT
CABIN LAKE AREA
WEST PAULINA AREA
FLAT TOP UNIT
ODELL UNIT
CRESCENT UNIT
SUMMIT STAGE UNIT
POT HOLES UNIT
BEAVER MARSH AREA
CHEMUL UNIT
DESCHUTES
JEFFERSON
CROOK
WILLAMETTE NATIONAL FOREST
OCHOCO NATIONAL FOREST
DESCHUTES NATIONAL FOREST
REDMOND
BEND
PRINEVILLE
Culver
Metolius
Terrebonne
Tumalo
Deschutes
Sisters
Black Crater
Mt Washington
Three Fingered Jack
North Sister
Middle Sister
South Sister
Belknap Crater
McKenzie Pass
Scott Mtn
Mt Jefferson
Mt Hood
Tumalo Mtn.
Elk Mtn
Elk Lake
Sheridan Mtn
Irish Mt
Cultus Mtn.
Lookout Mtn
Round Mtn
Squaw Bu
Maiden Pk
Wolf Mtn
Juniper Mtn
Hamner
Diamond Pk
Crescent Lake
Odell Lake
Summit Lake
Cowhorn Mtn
Potter Mtn
Tolo Mtn
Crater Mtn
Bald Mtn
Chemult
Mt Bailey
Mt Thielsen
Antelope Mtn
Fort Rock
Hayes Bu
Table Rk.
Silver Lake
Cougar Mtn
Grizzly
Powell Buttes
Eagle Rk.
Taylor Bu
Bear Buttes
Lyle Falls
Cline Buttes
Terrebonne
Crescent Mtn
Twin Buttes
Carpenterville Mtn
Blue River
McKenzie Bridge
Monument Pk
Idanha
Lionshead
Whitewater
Pyramid Cr
Santiam
Brush Creek
Canyon Creek
Three Fingered Jack
Maxwell Bu
Big Lake
Hoodoo
Six Creek
Allen Creek
McKay Cr
Old Dry Cr
Mill Creek
Ochoco Cr
Dry Cr
Eagle Rk.
Taylor Bu
Bear Buttes
Little Brasher
Willamette River
Mud L
Christy
Fk
Salmon
Black
Salt
Hills
Squaw Bu
Maiden Pk
Wolf Mtn
Juniper Mtn

Introduction.

Although general beetle cruises and loss estimates for portions of the Deschutes National Forest have been made by the Forest Service or by the Bureau of Entomology and Plant Quarantine since 1916, it was not until 1931 that the first permanent sample plot was established on this Forest for insect survey and research purposes. Since that time, additional half-section plots have been set up in representative portions of the Forest in order to follow systematically the progress of insect losses in the ponderosa pine stands. The annual cruises of these plots and general observations have been the basis for the annual beetle surveys of this Forest. The purpose of these surveys is threefold: (1) To determine the infestation trends of the western pine beetle (Dendroctonus brevicomis Lec.), (2) to locate areas of high loss which need control work or early cutting, and (3) to aid Forest officers in becoming familiar with the work of the western pine beetle and assist them to recognize incipient epidemic infestations.

History of the Surveys.

The first cooperative beetle survey based on plot data was made in 1931. F. P. Keen and W. J. Buckhorn of the Bureau of Entomology were assisted by District Ranger P. A. South in cruising the check plots on the Silver Lake and Crescent Areas. The survey in 1932 was extended to include portions of the Sisters Ranger District and was completed by W. J. Buckhorn and J. M. Whiteside of the Portland forest insect laboratory, with the assistance of District Rangers P. A. South and R. C. Burgess. In 1933, Camp Sisters CCC enrollees P. Bessler, J. Weisman, and C. C. Julian assisted J. M. Whiteside in the survey work on the Sisters Area, while K. Hunter and C. E. Hein of the U. S. Forest Service aided W. J. Buckhorn on the Silver Lake Area. Mr. E. L. Kolbe of the Pacific Northwest Forest and Range Experiment Station and F. P. Keen completed the work in 1933 on the Crescent Area. In 1934 the Deschutes National Forest provided funds for the employment of W. V. Catlow, L. Hodson, C. E. Hein, and H. L. Henries to act as field assistants and to make a pine beetle survey of the Sisters Area under the technical supervision of A. J. Jaenicke of the Portland office of the Forest Service. During this same year W. J. Buckhorn, with the help of Field Assistants D. H. Wood, S. R. Johnson, and C. Gordon, conducted the plot work on the Crescent and Silver Lake Areas. Work was continued on the same basis in 1935 when the

Deschutes National Forest employed F. Zumbrun, E. Putman, H. Miller, H. Heiser, A. Derrick, and C. E. Hein as Field Assistants for the plot work and general beetle survey of the Deschutes. W. J. Buckhorn and A. J. Jaenicke directed the survey.

The 1936 survey was made by a crew composed of A. Derrick, D. Clark, and H. Miller, and again the technical direction of the work was handled by Messrs. Buckhorn and Jaenicke. In 1937 the Regional Office hired 18 forestry students as Student Assistants from ECW funds and five Field Assistants from regular Insect Control funds to make a pine beetle survey of the ponderosa pine of eastern Oregon and eastern Washington on the national forests and intermingled private timber. The 23 men employed were trained in insect survey methods at Camp Sisters before they were divided into four crews of five men each and one crew of three men. The training job was a joint undertaking of the Bureau of Entomology and Plant Quarantine and the Regional Office of the Forest Service. As part of the training program, eight plots were cruised in the Sisters Area. Two crews were assigned for part of the field season to the Deschutes National Forest, the first consisting of R. F. Goodall (Crew Leader), A. G. Crum, and R. M. Fishback, who completed the regular assignment under the technical supervision of W. J. Buckhorn. The second crew composed of R. C. Grant (Crew Leader), J. B. Gabriel, R. E. Geoghegan, G. M. Feil, and E. A. Brackett, conducted two weeks of plot work on the Cabin Lake Area under the direction of A. J. Jaenicke. For the 1938 pine beetle survey, 15 men were hired on July 3. They were mostly seniors and graduates from forestry schools. The survey was financed by the Forest Service from Insect Control funds and by the Bureau of Entomology and Plant Quarantine. The five three-man crews were trained for two weeks at Camp Sisters on the Deschutes, and the eight plots in that vicinity were again surveyed as part of the training program. The Deschutes National Forest crew, consisting of R. C. Grant (Crew Leader), C. H. Neth, and W. A. Johnson, was under the technical supervision of A. J. Jaenicke of the Regional Office and completed the assignment in one month before proceeding to the Fremont for similar survey work.

Survey Methods.

The annual survey has usually consisted of making a 100 percent cruise of the insect-killed trees on half-section plots. In 1935 and 1936 the plot data on the Deschutes were supplemented by strip cruises. The strips were five chains wide and of indefinite length.

All insect-killed trees on the strips were counted and classified according to the approximate year of their attack. These strip cruises aided in making estimates of past insect losses. Ten percent cruises of the green timber have been made on a majority of the plots, and in 1938 some of the old plots previously cruised by the strip method were recruised using the one-quarter acre randomized sample plots. This method of cruising is easily combined with spotting, but as yet no conclusions have been reached concerning the results as compared with the other method of cruising. The 1938 survey work was supplemented by extensive methods consisting of observational mapping, in which the pine areas were colored according to the severity of the 1937 beetle losses. The 1938 losses could not be mapped because fading of the 1938 overwintering generation trees was not apparent at the time of the 1938 survey. During the 1938 survey, several permanent ten-acre and temporary acre plots were studied in the field. These plots furnished data which are valuable in determining the relation of pine beetle damage to various ecological and physiological factors.

Description of the Pine Stands.

The Deschutes National Forest and the intermingled private lands contain approximately 10.5 billion board feet of ponderosa pine and somewhat over one million acres in the central portion of the pine belt of Oregon. It is bordered on the west for one hundred miles by the upper slope forest types of the Cascade Range, and slopes eastward to the non-timbered region.

For entomological survey purposes, the Forest has been divided into seven infestation areas based on natural boundaries. Each area consists of one or more subdivisions called "units".

The Sisters Area, occupying 30 percent of the pine acreage of the Forest, lies partly in a protected basin between Green Ridge on the east and the Cascade Range on the west, and extends southward to cut-over land and eastward to the juniper and sagebrush types.

The Panhandle Area, comprising nine percent of the total acreage but only two percent of the pine volume, lies south and east of Bend, Oreg. This area, bordered on one side by a treeless region and on the other by cut-over lands, consists of level terrain, the greater part of which has been cut over in the last 20 years.

Lying south of the Sisters Area and occupying a large portion of the west half of the Deschutes is the Crescent Area, which probably exhibits the best conditions for tree growth on the Forest. Bounded on the west by the upper slope types of the Cascades and on the east by lodgepole pine land, this area is comparatively the most rugged and receives the most precipitation of any portion of the Forest. It occupies 21 percent of the pine acreage and 27 percent of the volume, but the Big Spring Unit, lying in the northeast corner, has been completely cut out.

The West Paulina Area lies in the south-central portion of the Forest and comprises about 18 percent of the pine acreage. It is bounded on the north by cut-over lands, on the east by lodgepole pine flats, on the south by the Klamath Indian Reservation, and on the west by the Paulina Mountains and lesser peaks.

The Cabin Lake Area, bounded on the east by the Paulina Mountains, slopes eastward to the level country where the timber converges with the desert. This area is considered one of the driest in the region and the absorbent pumice soil has prevented any stream formation.

The two remaining areas, Silver Lake and Beaver Marsh, are located respectively in the southeast and southwest portions of the Forest. The Silver Lake Area is largely in the Fremont National Forest; but one unit, the Pot Holes Unit, is inside the boundaries of the Deschutes Forest and consists of level country which lies adjacent to the desert on the east side and is bordered by a ridge of pine timber on the west. The Beaver Marsh Area is located mostly in the Rogue River National Forest, and is bordered on the west by the Cascade Mountains and on the east by lodgepole pine flats. Only the Chemult Unit of the Beaver Marsh Area is within the boundaries of the Deschutes National Forest.

Further information concerning the boundaries and ponderosa pine stands of the areas and units is given in Figure 1 and Table No. 2. From the map it can be seen that the Summit Stage and Crescent Units of the Paulina Area overlap into the Fremont National Forest. However, the amount of timber on these two units which lies in the Fremont is negligible and it is included as a part of the Deschutes in order that the two units may be described completely in this one report. It should also be noted that a small part of the Deschutes lying east of Chemult is not included in this report. This small amount of forest is included in the Walker Rim Unit of the Klamath Marsh Area and is discussed in the Fremont report.

Pine Beetle Losses in Ponderosa Pine.

The sample plot data for the period 1931 to 1937 show 1931 as a high loss year, with the beetle losses falling to a low ebb in 1933 and subsequently increasing until a peak loss was again reached in 1935. Our plot data and observational records show that 1937 was a low year and that the pine beetle losses in ponderosa pine were greater in 1938 than in 1937. The greatest losses during the period 1931 to 1938 occurred in 1935, when 1.37 percent of the stand was killed. The loss in 1937 amounted to only 0.54 percent of the volume. The check plots show an annual average stand loss of 0.82 percent, and a gross loss of 6.35 percent for the seven-year period 1931 to 1937. These loss percentages are representative of conditions found on the Forest as a whole, but they frequently do not reveal the true picture of pine beetle losses occurring on individual portions of the Forest. For example, epidemic conditions were found in parts of the Sisters Area in 1931 and 1932, while in 1934 and 1935 severe infestations were in progress in the Cabin Lake, Silver Lake, and West Paulina Areas. The complete loss figures for the calendar year 1938 will not be available until the 1939 survey has been made. It is for this reason that the 1938 losses are not included in any of the tables except Table 6. More detailed information concerning trends in different portions of the Forest for the years 1931 to 1938 can be found in Tables 2, 3, and 4.

The check plots were cruised in 1938 at a time when it was possible to pick up an average of only 30 percent of the total 1938 depletion, and consequently it is necessary to estimate, by means of factors based on past studies, the total 1938 loss. The ratio of the estimated 1938 loss to the actual 1937 loss is two to one. In Table 5, the plots have been listed chronologically on a basis of cruising dates and the relation of the 1938 loss to 1937 depletion is shown by individual sample plots.

A 1937 infestation map was made of the Forest (Figure 2) showing the distribution of four intensities of beetle losses. Light and moderate epidemics occurred in 1937 on the Cabin Lake, Sisters, and Silver Lake Areas. In view of the increases over the 1937 losses which occurred in 1938, these areas warrant special consideration in 1939.

Control Work.

No control work was carried on in 1938 on the Deschutes National Forest, but during the period 1933 to 1937 one or two projects were completed each year. Some of the projects have been cooperatively financed by the Forest Service and private industry, and others by the Forest Service alone. Treating has consisted almost entirely of the peeling and burning method and some sun-curing. In the spring of 1936 the Brooks-Scanlon Lumber Company salvaged some insect-killed trees on the Fox Butte and China Hat projects. The removal of the major portion of the boles of the infested trees greatly reduced the cost of the control work, but the feasibility of salvage not only as a means of controlling epidemics but as a sound economic logging and milling enterprise is not completely known. The Shevlin-Hixon Lumber Company tried salvage operations as a partial substitute for control work in 1935 and 1936 on its own holdings, with results that showed only slight advantages over the regular cut and peel method. The scattered manner in which the infested trees occur, the low merchantability of much of the infested length of the trees, and the rapidity with which blue stain affects the sapwood of infested trees, all tended to make salvage operations less profitable to the Shevlin-Hixon Lumber Company. Table 7 lists the control projects undertaken on the Forest since 1933.

Conclusions and Recommendations.

The last high peak of pine beetle losses was reached in 1935 and beetle activities remained in an endemic state during 1936 and 1937 in most of the ponderosa pine on the Forest. The year 1937 was the lowest in the history of the surveys, but the 1938 survey indicates an appreciable increase in beetle activity in 1938 over 1937 in certain areas.

Light and moderate epidemics occurred in 1937 in parts of the Silver Lake, Cabin Lake, and east half of the Sisters Areas. These three areas should receive special consideration in 1939, especially since the 1938 infestation trend was upward.

The present status of pine beetle activity on the Forest does not warrant control measures during the spring of 1939.

Table No. 1

Ponderosa Pine Acreages and Volumes by Infestation Areas and Units on the Deschutes National Forest, as of January 1, 1938

Area & Unit	Pine Acreage	Pine Volume, M.b.m.	Percent of Total Acreage	Percent of Total Volume
SISTERS				
Grandview	119,000	1,172,000		
Metolius	70,000	793,000		
McKenzie	80,000	1,198,000		
Tumalo	71,000	631,000		
Total	340,000	3,794,000	30	36
PANHANDLE				
Panhandle	68,000	28,000		
Orphan Butte	38,000	141,000		
Total	106,000	169,000	9	2
CRESCENT				
Davis	55,000	904,000		
Pringle Falls	31,000	358,000		
Fall River	62,000	835,000		
Big Spring	54,000	100,000		
Odell	48,000	536,000		
Total	250,000	2,733,000	21	26
WEST PAULINA				
Lava Butte	61,000	68,000		
Finley Butte	66,000	495,000		
Crescent	44,000	564,000		
Summit Stage	39,000	508,000		
Total	210,000	1,635,000	18	16

(continued)

Table No. 1
(continued)

Ponderosa Pine Acreages and Volumes by Infestation Areas and Units on the Deschutes National Forest, as of January 1, 1938

Area & Unit	Pine Acreage	Pine Volume, M.b.m.	Percent of Total Acreage	Percent of Total Volume
CABIN LAKE				
Cabin Lake	59,000	579,000		
Sixteen Butte	25,000	186,000		
Fox Butte	46,000	59,000		
China Hat	8,000	94,000		
Pine Mountain	6,000	63,000		
Flat Top	63,000	670,000		
Total	207,000	1,651,000	18	16
SILVER LAKE				
Pot Holes	22,000	239,000	2	2
BEAVER MARSH				
Chemult	26,000	196,000	2	2
GRAND TOTAL	1,161,000	10,417,000	100	100

Table No. 2

Timbered Acreages, Ponderosa Pine Volumes, and Annual Beetle Losses in Ponderosa Pine on Individual Sample Plots

Area Unit and Plot Location	Timbered Acres and Stand Volume, M.b.m.		Site	Beetle Losses in Ponderosa Pine: Year of Attack	Trees Killed	Bd.ft. Volume Killed	Bd.ft. Loss per A.	Percent Stand Killed
SISTERS AREA	160A.	2,730		1931	38	25,860	162	.95
	160A.	2,704		1932	49	33,155	206	1.22
Metolius	160A.	2,671		1933	24	25,165	157	.94
T. 12S, R. 9E,	320A.	5,002	3-	1934	28	25,130	79	.50
Sec. 35N½	320A.	4,985		1935	21	16,900	53	.34
	320A.	4,966		1936	32	19,000	59	.38
	320A.	4,954		1937	17	12,070	38	.24
		6,306		1931	76	67,190	212	1.06
Metolius		6,239		1932	104	82,110	256	1.32
T. 13S, R. 9E,		6,157		1933	16	25,235	79	.41
Sec. 5E½	320A.	6,132	3-	1934	22	15,560	49	.25
		6,116		1935	16	13,210	41	.22
		6,103		1936	18	24,190	75	.40
		6,079		1937	19	26,620	83	.44
		8,958		1931	106	73,230	229	.82
Metolius		8,885		1932	100	60,125	188	.68
T. 13S, R. 9E,		8,824		1933	23	18,920	59	.21
Sec. 29E½	320A.	8,806	4	1934	28	12,230	38	.14
		8,793		1935	18	12,350	39	.14
		8,781		1936	11	7,140	22	.08
		8,774		1937	28	12,650	40	.14
		5,991		1931	39	26,000	81	.44
Metolius		5,965		1932	62	54,390	170	.91
T. 13S, R. 9E,	320A.	5,911	4+	1933	45	32,210	101	.54
Sec. 14N½		5,879		1934	24	18,730	59	.32

(continued)

Table No. 2
(continued)

Area Unit and Plot Location	Timbered Acres and Stand Volume, M.b.m.	Site	Beetle Losses in Ponderosa Pine: Year of Attack	Trees Killed	Bd.ft. Volume Killed	Bd.ft. Loss per A.	Percent Stand Killed
SISTERS AREA (cont.)	4,582		1931	73	55,190	172	1.20
	4,527		1932	69	62,900	197	1.39
Metolius	320A. 4,464	4	1933	44	62,535	196	1.40
T. 12S, R. 9E,	4,402		1934	47	52,030	163	1.18
Sec. 21							
	160A. 2,441		1931	57	39,980	250	1.64
	160A. 2,401		1932	37	29,945	187	1.25
McKenzie	160A. 2,371		1933	5	2,280	14	.09
T. 14S, R. 9E,	320A. 5,426	4	1934	34	26,000	81	.48
Sec. 34S½	320A. 5,416		1935	68	37,970	118	.70
	320A. 5,378		1936	36	18,020	56	.34
	320A. 5,360		1937	28	20,670	65	.38
McKenzie							
T. 15S, R. 9E,	320A. 6,850	4	1937	36	27,410	86	.40
Sec. 14W½							
Grandview	3,217		1935	365	110,772	346	3.44
T. 13S, R. 10E,	320A. 3,106	5-	1936	213	71,880	226	2.32
Sec. 27E½	3,034		1937	54	33,500	105	1.10
Grandview							
T. 12S, R. 10E,	320A. 4,621	4	1937	37	17,360	54	.38
Sec. 33E½							
Tumalo	3,581		1935	154	74,070	231	2.07
T. 16S, R. 10E,	320A. 3,504	4-	1936	74	47,990	150	1.37
Sec. 16W½	3,456		1937	65	42,875	134	1.24
Tumalo	2,680		1935	114	80,810	252	3.02
T. 17S, R. 11E,	320A. 2,599	4	1936	101	65,250	204	2.51
Sec. 28E½	2,534		1937	89	61,095	191	2.41

(continued)

Table No. 2
(continued)

Area Unit and Plot Location	Timbered Acres and Stand Volume M.b.m.	Site	Beetle Losses in Ponderosa Pine: Year of Attack	Trees Killed	Bd.ft. Volume Killed	Bd.ft. Loss per A.	Percent Stand Killed
WEST PAULINA AREA							
Finley Butte	240A. 2,716	4	1935	1	970	4	.04
T. 23S, R. 11E,	2,715		1936	16	9,580	40	.35
Sec. 29N½	2,705		1937	7	5,180	22	.19
Finley Butte	1,925		1935	1	1,750	9	.09
T. 22S, R. 11E,	200A. 1,923	4	1936	2	1,330	7	.07
Sec. 26N½							
Summit Stage	3,415		1935	55	34,620	108	1.01
T. 25S, R. 11E,	320A. 3,380	4-	1936	45	28,280	88	.84
Sec. 11E½	3,352		1937	32	21,340	67	.64
Summit Stage	1,268		1932	1	700	4	.05
T. 24S, R. 11 E,	160A. 1,267	4-	1933	6	2,680	17	.21
Sec. 21	1,265		1934	4	5,290	33	.42
Summit Stage	335		1932	1	530	5	.16
T. 24S, R. 11E,	100A. 334	4-	1933	1	700	7	.21
Sec. 22	334		1934	0	0	0	0
Summit Stage	975		1932	0	0	0	0
T. 24S, R. 11E,	160A. 975	4-	1933	5	7,820	49	.80
Sec. 27	977		1934	23	19,620	123	2.00
Summit Stage	5,800		1932	17	12,450	19	.20
T. 24S, R. 11E,	640A. 5,788	4-	1933	60	33,030	52	.57
Sec. 28	5,755		1934	143	86,270	135	1.50
Summit Stage	3,540		1932	6	2,200	6	.06
T. 24S, R. 11E,	380A. 3,338	4-	1933	24	20,080	55	.62
Sec. 32	3,518		1934	59	40,470	106	1.15
Summit Stage	1,500		1932	0	0	0	0
T. 24S, R. 11E,	270A. 1,500	4-	1933	24	22,210	82	1.48
Sec. 33N½	1,478		1934	22	11,240	42	.76

(continued)

Table No. 2
(continued)

Area Unit and Plot Location	Timbered Acres and Stand Volume M.b.m.	Site	Beetle Losses In Ponderosa Pine: Year of Attack	Trees Killed	Bd.ft. Volume Killed	Bd.ft. Loss per A.	Percent Stand Killed
WEST PAULINA AREA (cont.):							
Crescent T. 24S, R. 9E, Sec. 15S½	320A. 5,412	4	1937	13	7,580	24	.14
CRESCENT AREA							
Pringle Falls T. 21S, R. 9E, Sec. 35S½	320A. 5,808	4+	1935	12	6,570	21	.11
	320A. 5,801		1936	26	21,010	66	.36
	320A. 5,780		1937	20	13,245	43	.24
Pringle Falls T. 21S, R. 9E, Sec. 24	320A. 6,051	4+	1931	16	25,940	81	.43
	320A. 6,025		1932	13	12,110	38	.20
	320A. 6,013		1933	9	18,080	56	.30
Davis T. 23S, R. 8E, Sec. 32S½	320A. 6,402	3	1937	12	8,350	26	.13
PANHANDLE AREA	4,017		1932	108	52,200	163	1.30
	3,964		1933	115	55,500	173	1.40
Orphan Butte T. 20S, R. 14E, Sec. 35W½	320A. 3,909	5	1934	132	128,220	400	3.28
	3,780		1935	311	233,420	727	6.16
	3,547		1936	132	72,120	224	2.28
Orphan Butte T. 20S, R. 14E, Sec. 20	480A. 878	4	1931	78			
			1932	107	52,240		
			1933	139	64,270		
			1934	296	83,180		
Orphan Butte T. 20S, R. 14E, Sec. 21W½	320A. 582	4	1931	33			
			1932	31	14,000		
			1933	66	35,240		
			1934	143	52,380		
Panhandle T. 20S, R. 14E, Sec. 7E½	320A.		1931	48			
			1932	84			
			1933	110			

(continued)

Table No. 2
(continued)

Area Unit and Plot Location	Timbered Acres and Stand Volume M.b.m.	Site	Beetle Losses in Ponderosa Pine: Year of Attack	Trees Killed	Bd.ft. Volume Killed	Bd.ft. Loss per A.	Percent Stand Killed
PANHANDLE AREA (cont.)							
			1931	102			
Panhandle			1932	117			
T. 19S, R. 13E,	320A.	4-	1933	128	90,240		
Sec. 23N½							
SILVER LAKE AREA	2,424		1931	97	67,880	212	2.79
	2,356		1932	160	109,130	341	4.64
Pot Holes	2,247		1933	103	62,190	194	2.76
T. 25S, R. 12E,	320A. 2,184	4	1934	174	119,290	373	5.46
Sec. 25N½	2,065		1935	123	48,020	134	2.32
	2,017		1936	126	75,650	236	3.74
	1,942		1937	53	42,000	131	2.16
CABIN LAKE AREA							
	3,458		1935	80	50,380	157	1.45
Flat Top	320A. 3,408	4	1936	58	30,740	96	.90
T. 23S, R. 12E,	3,378		1937	46	22,570	70	.67
Sec. 35E½							
Flat Top	3,328		1935	47	34,850	109	1.05
T. 24S, R. 13E,	320A. 3,294	4+	1936	30	20,220	63	.63
Sec. 20E½	3,273		1937	17	11,035	34	.37
Cabin Lake	2,193		1935	58	50,180	157	2.28
T. 23S, R. 14E,	320A. 2,243	4	1936	24	20,300	63	.95
Sec. 29E½	2,222		1937	13	13,430	42	.61
Cabin Lake							
T. 23S, R. 13E,	320A. 4,701	4	1937	12	13,220	41	.28
Sec. 10S½							
Sixteen Butte							
T. 23S, R. 14E,	320A. 1,698	4	1937	98	46,710	146	2.75
Sec. 1W½							
Sixteen Butte							
T. 23S, R. 14E,	300A. 1,717	4	1937	26	17,030	57	.99
Sec. 24E½							

(continued)

Table No. 2
(continued)

Area Unit and Plot Location	Timbered Acres and Stand Volume M.b.m.	Site	Beetle Losses in Ponderosa Pine: Year of Attack	Trees Killed	Bd.ft. Volume Killed	Bd.ft. Loss per A.	Percent Stand Killed
CABIN LAKE AREA (cont.):							
Sixteen Butte T. 23S, R. 15E, Sec. 8W½	240A. 3,341	4	1937	20	12,540	52	.38
Sixteen Butte T. 23S, R. 15E, Sec. 18W½	310A. 2,749	4	1937	38	23,765	77	.86
Fox Butte T. 23S, R. 16E, Sec. 31W½	320A. 2,802	4-	1935	129	100,600	313	3.58
	2,702		1936	23	23,420	73	.87
	2,679		1937	6	910	3	.03

Wig Top 320A 1937 HL 22145
23S, 15E, 22E½

TABLE NO. 3

SUMMARY OF PONDEROSA PINE

LOSSES ON SAMPLE PLOTS

BY INFESTATION AREAS

Table No. 3-A

Summary of Cruising Data on Sample Plots

Sisters Area

Year of Attack	No. of Plots	Timbered Acres Cruised	Trees Killed	Bd.ft. Volume Killed	Trees Killed per Section	Bd.ft. Killed per Acre	% of Stand Killed	Bd.ft.volume of Living Ponderosa Pine Stand
Totals for All plots								
1931	6	1,600	389	287,450	156	179	0.93	31,009,000
1932	6	1,600	421	322,625	168	202	1.05	30,722,000
1933	6	1,600	157	166,345	63	104	0.55	30,399,000
1934	6	1,920	183	149,680	61	78	0.42	35,646,000
1935	7	2,240	756	346,082	216	154	0.96	34,786,000
1936	7	2,240	485	253,470	138	113	0.76	34,438,000
1937	9	2,880	373	254,250	83	88	0.58	45,662,000
Totals for Continuous Plots								
1931	4	960	277	206,260	186	215	1.08	20,435,000
1932	4	960	290	205,335	188	214	1.13	20,229,000
1933	4	960	68	71,600	48	75	0:36	20,024,000
1934	4	1280	112	78,920	87	62	0.31	25,366,000
1935	4	1,280	123	80,430	106	63	0.32	25,311,000
1936	4	1,280	97	68,350	82	53	0.27	25,231,000
1937	4	1,280	92	72,010	68	56	0.28	25,162,000

Table No. 3-B

Summary of Cruising Data on Sample Plots

Panhandle Area

Year of Attack	No. of Plots	Timbered Acres Cruised	Trees Killed	Bd.ft. Volume Killed	Trees Killed per Section	Bd.ft. Killed per Acre	% of Stand Killed	Bd.ft.Volume of living Ponderosa Pine Stand
			Totals for All Plots					
1932	1	320	108	52,200	216	163	1.30	4,017,000
1933	1	320	115	55,500	230	173	1.40	3,964,000
1934	1	320	132	128,220	264	402	3.28	3,909,000
1935	1	320	311	233,420	622	728	6.18	3,781,000
1936	1	320	132	72,120	264	225	2.03	3,547,000

Table No. 3-C

Summary of Cruising Data on Sample Plots

Crescent Area

Year of Attack	No. of Plots	Timbered Acres Cruised	Trees Killed	Bd.ft. Volume Killed	Trees Killed per Section	Bd.ft. Killed per Acre	% of Stand Killed	Bd.ft.Volume of living Ponderosa Pine Stand
Totals for All Plots								
1931	1	320	16	25,940	32	79	.43	6,051,000
1932	1	320	13	12,110	26	38	.20	6,025,000
1933	1	320	9	18,080	18	57	.30	6,013,000
1934	0							
1935	1	320	12	6,570	24	22	.11	5,808,000
1936	1	320	26	21,010	52	66	.36	5,801,000
1937	3	960	45	29,775	90	31	.17	17,595,000
Totals for Continuous Plots								
1935	1	320	12	6,570	24	22	.11	5,808,000
1936	1	320	26	21,010	52	66	.36	5,801,000
1937	1	320	20	13,845	40	43	.24	5,780,000

Table No. 3-D

Summary of Cruising Data on Sample Plots

West Paulina Area

Year of Attack	No. of Plots	Timbered Acres Cruised	Trees Killed	Bd.ft. Volume Killed	Trees Killed per Section	Bd.ft. Killed per Acre	% of Stand Killed	Bd.ft.Volume of living Ponderosa Pine Stand
Totals for All Plots								
1932	6	1,710	25	15,880	9	9.3	.12	13,418,000
1933	6	1,710	120	86,520	44	51	.56	13,402,000
1934	6	1,710	251	162,890	91	94	1.22	13,326,000
1935	3	760	57	37,340	47	49	.46	8,055,000
1936	3	760	63	39,190	52	51	.49	8,018,000
1937	2	560	39	26,520	44	47	.44	6,057,000
Totals for Continuous Plots								
1935	2	560	56	35,590	64	64	.60	6,131,000
1936	2	560	61	37,860	69	68	.62	6,095,000
1937	2	560	39	26,520	44	47	.44	6,057,000

Table No. 3-E

Summary of Cruising Data on Sample Plots

Cabin Lake Area

Year of Attack	No. of Plots	Timbered Acres Cruised	Trees Killed	Bd.ft. Volume Killed	Trees Killed per Section	Bd.ft. Killed per Acre	% of Stand Killed	Bd.ft.Volume of living Ponderosa Pine Stand
Totals for All Plots								
1935	4	1280	314	236,010	107	184	2.00	11,781,000
1936	4	1280	135	94,680	77	74	.81	11,647,000
1937	10	3220	315	187,295	63	59	.65	29,041,000
Totals for Continuous Plots								
1935	3	960	185	135,410	123	140	1.50	8,979,000
1936	3	960	112	71,260	75	74	.81	8,944,000
1937	3	960	76	47,035	51	49	.52	8,873,000

Table No. 4

Summary of Loss Data in Ponderosa Pine for All Sample Plots

Deschutes National Forest
1931-1937

Year of Attack	No. of Plots	Timbered Acres Cruised	Trees Killed	Bd.ft. Volume Killed	Trees Killed per Section	Bd.ft. Killed per Acre	% of Stand Killed	Bd.ft.Volume of living Ponderosa Pine Stand
1931	8	2,240	502	381,270	143	170	.97	39,484,000
1932	15	4,270	727	511,945	109	120	.90	56,538,000
1933	15	4,270	504	388,635	76	91	.69	56,026,000
1934	14	4,270	740	560,080	111	131	1.02	55,065,000
1935	17	5,240	1,573	907,442	192	173	1.37	66,277,000
1936	17	5,240	967	556,120	118	106	.86	65,469,000
1937	25	8,130	835	539,840	66	66	.54	99,165,000
Mean					102	114	.89	

Table No. 5

Estimated Ratios of 1938 Losses to 1937 Losses on Sample Plots

Plot	Site	Elev. Feet	Date of Cruise 1938	1937 Loss: 1st Cruise	1937 Loss: Total	1938 Loss: Marked	1938 Loss: Est. Total	Ratio 1938 to 1937
Cold Spring	4	3,450	7-19	8	28	20	133	4.74
Prairie Farm	4	4,000	7-19	10	37	19	126	3.41
Squaw Ridge	5-	3,900	7-19	17	54	13	86	1.59
Melvin Butte	4-	3,900	7-19	18	65	19	126	1.94
Allingham	3-	3,300	7-20	0	17	11	68	3.98
Jack Creek	3-	3,000	7-20	6	19	7	43	2.26
Black Butte	4	3,100	7-20	4	28	10	62	2.22
Brush Draw	4	3,500	7-20	6	36	13	81	2.25
Cabin Lake	4	4,600	7-25	5	13	4	20	1.54
Flat Top	4+	4,200	7-26	9	17	7	26	1.53
Tom Butte	4	5,300	7-27	9	12	3	13	1.08
Dead Log Butte	4	4,300	7-29	20	38	23	100	2.63
Sub-total				112	364	149	884	2.43
Crater Butte	4	5,200	8-1	15	46	23	88	1.91
Poly Top	4	5,200	8-3	43	98	40	148	1.51
Gebhardt Well	4	4,700	8-5	18	53	43	148	2.79
Summit Stage	4-	4,900	8-5	22	32	9	31	.97
Moffit Butte	4	4,350	8-17	3	7	11	28	4.00
Pringle Falls	4+	4,400	8-18	13	20	12	30	1.50
Black Rock	3	5,200	8-19	2	12	19	59	4.92
Crescent	4	4,400	8-24	7	13	20	83	6.38
Sub-total				123	281	177	615	2.19
Tumalo	4	4,000	10-17	40	89	69	78	.88
Sixteen Butte	4	4,900	11-14	17	20	42	42	2.10
Horshoe Butte	4	4,500	11-16	22	26	34	34	1.31
Sub-total				79	135	145	154	1.14
TOTAL				314	780	471	1,653	2.12

Table No. 6

Estimated 1937 Pine Beetle Losses for Entire Infestation Units and Areas
Deschutes National Forest

Unit	Ponderosa Pine Acreage	Volume of Ponderosa Pine-1938 M.b.m.	Estimated 1937 Loss			
			Trees	Volume M.b.m.	Bd. ft. per Acre	Percent of Stand
SISTERS AREA						
Metolius	70,000	793,000	3,000	2,500	36	.32
Grandview	119,000	1,172,000	16,000	10,000	84	.85
McKenzie	80,000	1,198,000	6,000	4,500	56	.38
Tumalo	71,000	631,000	9,100	6,000	84	.95
Total	340,000	3,794,000	34,100	23,000	68	.61
PANHANDLE AREA						
Panhandle	68,000	28,000	1,500	390	6	1.39
Orphan Butte	38,000	141,000	1,400	726	19	.51
Total	106,000	169,000	2,900	1,116	11	.66
CRESCENT AREA						
Davis	55,000	904,000	2,100	2,090	38	.23
Pringle Falls	31,000	358,000	1,400	908	29	.25
Fall River	62,000	835,000	2,400	1,815	29	.22
Big Spring	54,000	100,000	2,100	644	12	.64
Odell	48,000	536,000	1,400	1,219	25	.23
Total	250,000	2,733,000	9,400	6,676	27	.24

(continued)

Table No. 6
(continued)

Unit	Ponderosa Pine Acreage	Volume of Ponderosa Pine-1938 M.b.m.	Estimated 1937 Loss			
			Trees	Volume M.b.m.	Bd. ft. per Acre	Percent of Stand
WEST PAULINA AREA						
Lava Butte	61,000	68,000	1,300	468	8	.69
Finley Butte	66,000	495,000	2,400	1,330	20	.27
Crescent	44,000	564,000	2,000	1,320	30	.23
Summit Stage	39,000	508,000	2,100	1,491	38	.27
Total	210,000	1,635,000	7,800	4,609	22	.28
CABIN LAKE AREA						
Cabin Lake	59,000	579,000	2,300	1,851	32	.32
Sixteen Butte	25,000	186,000	2,600	1,853	75	1.00
Fox Butte	46,000	59,000	1,100	554	12	.94
China Hat	8,000	94,000	800	549	69	.58
Pine Mountain	6,000	63,000	1,200	840	140	1.33
Flat Top	63,000	670,000	3,500	2,478	39	.37
Total	207,000	1,651,000	11,500	8,125	39	.49
SILVER LAKE AREA						
Pot Holes	22,000	239,000	2,700	2,156	98	.90
BEAVER MARSH AREA						
Chemult	26,000	196,000	1,500	963	37	.49
GRAND TOTAL	1,161,000	10,417,000	69,900	46,645	40	.45

Table No. 7

Summary of Control Work on the Deschutes National Forest under Direction of Forest Service
1933 - 1937

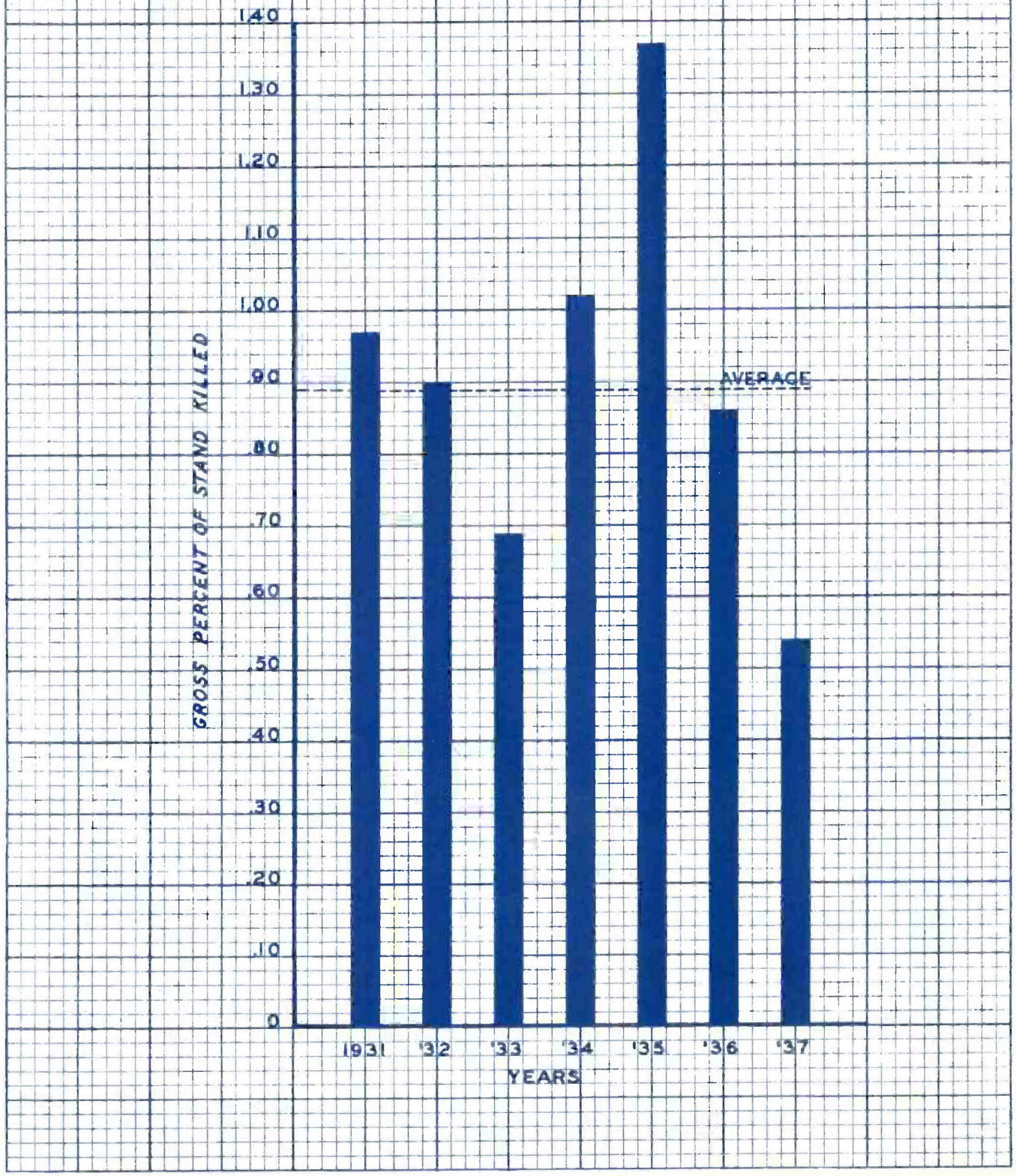
Control Period	Project	Trees Treated	Acres Covered	Cost		Work Done by
				Total	Per Tree	
Fall, 1933	Orphan Butte	3,055	16,660	$ 7,240	$2.37	NIRA
Fall, 1934	Flat Top	389	4,400	1,463	3.76	NIRA
Fall, 1934	Metolius	1,150	22,500	4,347	3.78	ECW
Spring, 1935	Flat Top	1,263	13,120	5,077	4.02	NIRA
Spring, 1935	Metolius	2,450	51,780	9,261	3.78	ECW
Fall, 1935	Sisters	418	9,400	1,827	4.37	ECW
Spring, 1936	China Hat	875	5,800	525	0.60	B.S.Salvage *
Spring, 1936	Fox Butte	600	2,550	264	0.44	B.S.Salvage *
Fall, 1936**	Sixteen Butte	585	6,000	2,194	3.75	ERA
Spring, 1937	Sixteen Butte	3,491	30,790	11,346	3.25	ERA
Spring, 1937	Pine Mountain	573	5,440	1,862	3.25	ERA

* Brooks-Scanlon Lumber Company did the salvage work.

** Project continued and completed in spring of 1937.

FIG. NO 3

TREND OF CHECK PLOT LOSSES
DESCHUTES NATIONAL FOREST, OREGON



EUGENE DIETZGEN CO.
NO. 340-10 EDCO EFFICIENCY 10 X 10 PER INCH
PRINTED IN U. S. A.

1938 PINE BEETLE SURVEY OF PONDEROSA PINE IN OREGON AND WASHINGTON

DESCHUTES N.E. INFESTATION AREA
OREGON

LEGEND

AREA BOUNDARIES

UNIT BOUNDARIES

1937 BEETLE LOSS

0-25 trees per section. Normal infestation. Roughly about 0 to 1/4 of one percent of stand volume.

25-50 trees per section. Normal infestation. 1/4 to 1/2 of one percent of stand volume.

50-100 trees per section. Light epidemic infestation. 1/2 to 1 percent of stand volume.

100-200 trees per section. Moderate epidemic infestation. 1 to 2 percent of stand volume.

200-400 trees per section. Heavy epidemic infestation. 2 to 4 percent of stand volume.

Over 400 trees per section. Very heavy epidemic infestation. Over 4 percent of stand volume.

PONDEROSA PINE TYPES

Solid colors. Stands containing more than 50% ponderosa pine and of average or better thrift and vigor. In these stands the western pine beetle is the chief tree-killing agent.

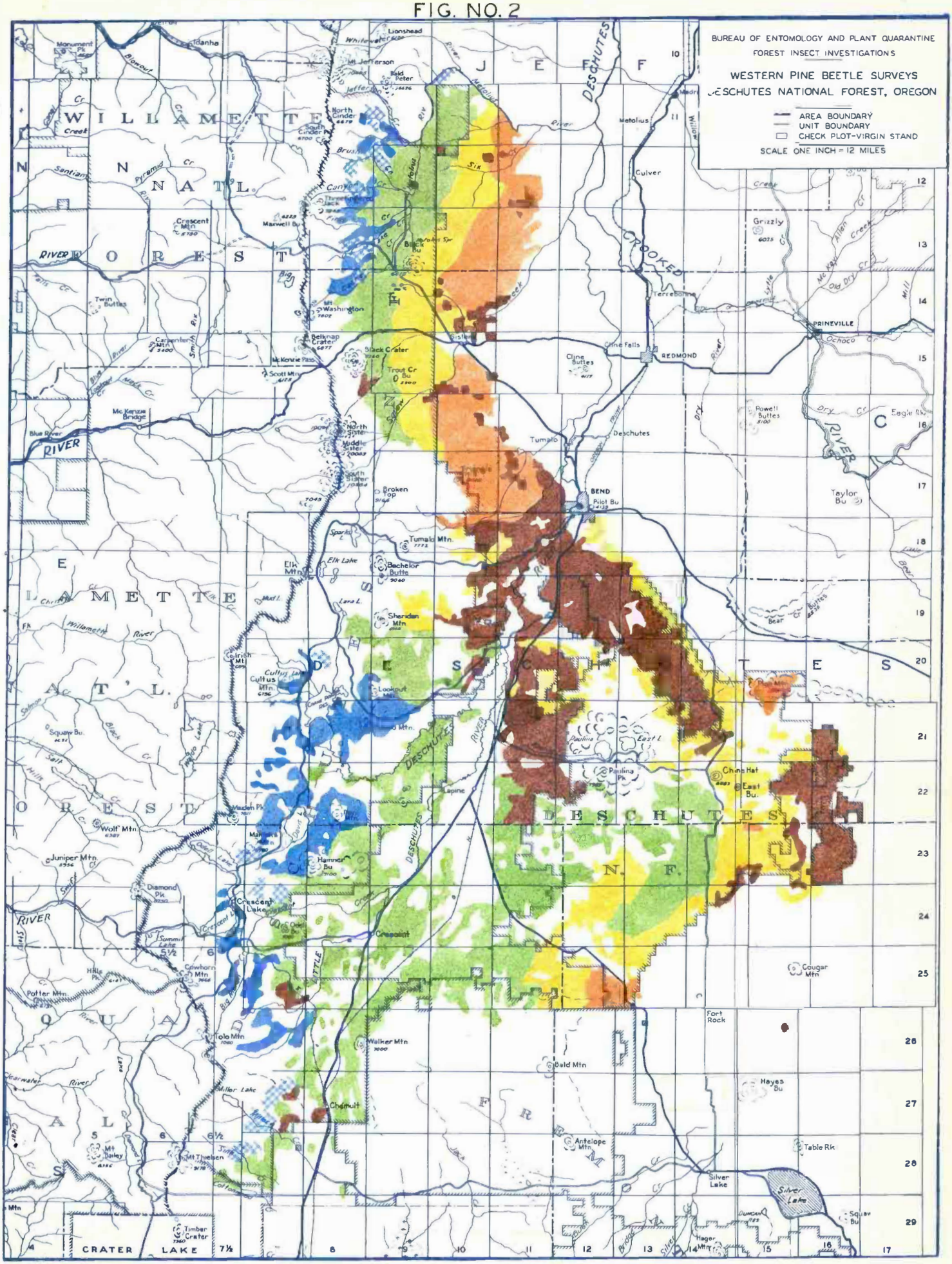
Cross-hatched colors. Stands containing from 20-50% ponderosa pine.

Dotted colors. Ponderosa pine stands of marginal or fringe type. In many of these areas drought as well as insects is an important tree-killing factor.

Cut-over areas.

U. S. BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
U. S. FOREST SERVICE
Portland, Oregon

FIG. NO. 2


BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
FOREST INSECT INVESTIGATIONS
WESTERN PINE BEETLE SURVEYS
DESCHUTES NATIONAL FOREST, OREGON
AREA BOUNDARY
UNIT BOUNDARY
CHECK PLOT-VIRGIN STAND
SCALE ONE INCH = 12 MILES
DESCHUTES
CROOKED
DESCHUTES N. F.
WILLAMETTE NATIONAL FOREST
OCHOCO N. F.
DESCHUTES NATIONAL FOREST
FREMONT N. F.
CRATER LAKE
REDMOND
BEND
PRINEVILLE
Lionshead
Mt Jefferson
Metolius
Culver
Grizzly
Terrebonne
Cline Falls
Tumalo
Deschutes
Broken Top
Tumalo Mtn.
Bachelor Butte
Elk Mtn
Elk Lake
Sheridan Mtn
Irish Mt
Cultus Mtn
Lookout Mtn
Paulina Pk
East Bu.
China Hat
Lapine
Crescent
Crescent Lake
Diamond Pk
Wolf Mtn
Juniper Mtn
Hamner Bu
Cougar Mtn
Fort Rock
Walker Mtn
Bald Mtn
Hayes Bu
Chemult
Antelope Mtn
Table Rk
Silver Lake
Timber Crater
Powell Buttes
Taylor Bu
Eagle Rk
Squaw Bu
Hager Mtn